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Exploitation of genetic variability and trait association studies in Indian mustard (*Brassica juncea* L.)

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Abstract
The present investigation entitled “Exploitation of Genetic variability and trait association studies in Indian mustard (*Brassica juncea* L.)” was carried out during *Rabi* 2021-22 with three environments. Experimental material consisted of 20 Indian mustard genotypes. The experiment was conducted in Randomized Complete Block Design, using recommended agronomic practices for normal growth of crop. Field experiment conducted at the village Naugaya, Bharatpur, Rajasthan during Rabi season 2017-18 and 2018-19. The mean, range, phenotypic, genotypic and environmental variance, genotypic and phenotypic coefficient of variation, heritability in broad sense and genetic advance were calculated. Path coefficient analysis was carried out using correlation coefficients to know the yield-contributing traits having true associations with seed yield. Improvement in seed yield can be achieved by selection using the correlation and path analysis data generated in this study. 1000-seed weight was positively correlated with siliqua length. 1000-seed weight and total siliquae/plant also had higher phenotypic and genotypic direct effects on seed yield/plant, revealing that indirect selection for these traits would be effective in improving seed yield. The high heritability coupled with high genetic advance for 1000-seed weight would also be of great use for indirect selection for improvement in seed yield. The material used in the study is of diverse nature and can be used in the breeding programme for development of improved genotypes in mustard.

Keywords: *Brassica juncea*, correlation, heritability, path analysis, variability

Introduction

Indian mustard [*B. juncea* (L.) Czern and Coss] is one of the most important oil seed crops of the country and it occupies considerably large acreage among the Brassica group of oil seed crops. India stands first both in acreage and production of rapeseed and mustard in Asia. Rapeseed and mustard is cultivated in an area of 6.30 million hectares with a production of 7.20 million metric tonnes and with an average yield of 1143 kg/ha. In India, mustard and rape seed are being grown largely in states like, Uttar Pradesh, Rajasthan, Haryana, Assam, Gujarat, Punjab, West Bengal and Madhya Pradesh.

Indian mustard is an amphidiploids (2n=36), derived from interspecific cross of *Brassica campestris* (2n=20) and *Brassica nigra* (2n=16) followed by natural chromosome doubling. The seeds are used as medicine, spices and as components in the preparation of salad, curries and pickles. The mustard is mainly grown for oil, the cake obtained after oil extractions widely used for cattle feeding. The unrefined oil is used for edible purpose in India. There is increasing interest in preparation of detoxified high functional mustard cake which is a good source of protein and minerals. The seeds of mustard contain 39 to 44% oil and 28 to 32% protein.

In spite of the availability of appropriate technologies to increase per unit area production of mustard, the total cultivated areas under these remain static. The oil crops occupy an important place in the economy of Indian agriculture. In the oil seed scenario of India groundnut ranks first and rapeseed-mustard second. In India, Madhya Pradesh is the second largest rapeseed-mustard growing state after Rajasthan. The production from this meager area increased manifold through the development of high yielding and oil content varieties and also free the challenge of loss in production due to biotic and abiotic factors like diseases, pests and moisture stress.

Method and Material

The experiment was laid out on Bharatpur district is located in the eastern part of Rajasthan. It stretches between 26º 41' 58.67” to 27º 49' 41.74” north latitude and 76º 52' 06.42’’ to 77º 47'

47' 05.51'' east longitude covering area of 5079.4 sq km. The maximum temperature during the month of May and June reaches up to 33.7 °C, whereas minimum temperature goes below 14.1 °C in the month of December or January. The average rainfall in this region is 698.21 mm which is mostly received during monsoon season between mid - June to end of September with little occasional showers in other seasons. Experimental material consisted of 20 Indian mustard genotypes. The experiment was conducted in Randomized Complete Block Design, using recommended agronomic practices for normal growth of crop. Experimental area was uniform in respect of topography and fertility.

The experiment was laid out design RCBD with 20 genotypes and three replication. The material used in the experiment was fertilizer dose NPK (80:40:40 kg/ha). The crop mustard 20 different genotypes, spacing of 30 cm X 10 cm. Observations were recorded on single plant basis. For recording single plant observations five competitive plants from each plot were randomly selected. All of the growth characters *viz*. plant height, number of branches, number of capsule and days of maturity etc.

Result and Discussion

The results obtained in the present investigation entitled "Exploitation of Genetic variability and trait association studies in Indian mustard (*Brassica juncea* L.)" was carried out with 20 genotypes of Indian mustard laid out in Randomized Complete Block Design at the village Naugaya, Bharatpur, Rajasthan, during *rabi* 2021-22. To assess variability in the germplasm, studied genetic parameters of variability. Correlation analysis was performed to find out the degree of relationship between the characters.

Significant and positive correlation was observed for seed yield per plant with number of primary branches per plant, number of secondary branches per plant, number of siliqua on main raceme and biological yield in all the environments. These traits showed stable performance in different environment seem to be major yield factors; hence selection of these traits will be effective for constructing plant type of Indian mustard for improvement seed yield in different environments. Plant height exhibited significant and positive correlation in EI, EII and EIII. Days to 50% flowering and days to maturity exhibited negative correlation in EI, EII and EIII of Indian mustard. These results indicated environmental factors influenced these associations, therefore these traits would not consider for improvement of seed yield.

High heritability coupled with high genetic advance as percentage of mean and estimates of genotypic coefficient of variation were higher for number of secondary branches per plant in all the environments of Indian mustard have consequent chances of improving these traits through simple selection, indicating additive gene action may be responsible for expression of these traits. The correlation and path analysis studies showed that for developing new plant type in Indian mustard should be multiple primary and secondary branches, more number of siliquae on main raceme, plant height, high biological yield and seed yield which improve the productivity of plant, while in addition to these traits large seed size should provide more emphasis for developing plant types in Indian mustard under different environments. A subsequent genetic diversity among the genotypes was observed. The maximum contribution towards the total divergence was found through days to 50% flowering, seed yield per plant and number of secondary branches per plant in Indian mustard. These traits were responsible for expressing maximum diversity between the clusters. Six advanced breeding lines *viz*., PM-30, Pusa Vijay, Varuna, PM-25, JMM-991, Pusa Mahak and RVM-1 were found most divergent are selected and be used for further hybridization/ breeding programme.

Table 1: Phenotypic correlation coefficients of Indian mustard

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of primary branches per plant	Number of secondary branches per plant	Number of siliquae on main raceme	Biological yield	Seed yield per plant (g)
Days to 50% flowering	1.0000	-0.216	0.106	0.264	0.194	-0.491**	0.069	-0.294
Days to maturity		1.0000	-0.038	-0.071	0.141	0.282	-0.066	0.359*
Plant height (cm)			1.0000	-0.040	0.263	-0.110	0.095	-0.142
Number of primary branches per plant				1.0000	0.414**	0.230	0.426**	0.325*
Number of secondary branches per plant					1.0000	0.181	0.081	0.287
Number of siliquae on main raceme						1.0000	0.122	0.891**
Biological yield							1.0000	0.226
Seed yield per plant (g)								1.0000

Table 2: Genotypic correlation coefficients of Indian mustard

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of primary branches per plant	Number of secondary branches per plant	Number of siliquae on main raceme	Biological yield	Seed yield per plant (g)
Days to 50% flowering	1.0000	-0.217	0.108	0.275	0.196	-0.493**	0.068	-0.297
Days to maturity		1.0000	-0.040	-0.074	0.139	0.285	-0.067	0.364*
Plant height (cm)			1.0000	-0.041	0.263	-0.111	0.097	-0.142
Number of primary branches per plant				1.0000	0.421**	0.232	0.435**	0.331*
Number of secondary branches per plant					1.0000	0.181	0.083	0.289
Number of siliquae on main raceme						1.0000	0.129	0.899**
Biological yield							1.0000	0.230
Seed yield per plant (g)								1.0000

*, ** significant at 5% and 1% level respectively

In the present study the path coefficient analysis revealed that number of siliquae on main raceme, number of primary branches per plant, number of secondary branches per plant, days to maturity and plant height had the highest positive direct effect on seed yield per plant. However, maximum negative direct effect on seed yield per plant was found through days to 50% flowering followed by biological yield in EI. Whereas in EII number of siliquae on main raceme had the highest positive direct effect on seed yield per plant, days to 50% flowering, days to maturity, biological yield and number of secondary branches per plant. However, maximum negative direct effect on seed yield per plant was found through plant height and number of primary branches per plant. While in EIII number of primary branches per plant had the highest positive direct effect on seed yield per plant, number of secondary branches per plant, days to maturity, plant height and number of siliquae on main raceme. However, maximum negative direct effect on seed yield per plant was found through biological yield and days to 50% flowering. However, maximum negative direct effect on seed yield per plant was found through number of primary branches per plant and plant height. There were environmental effect on phenological traits; correlation coefficient value differs in the environment factors like erratic rains, temperature fluctuations in different growth stages. Similar findings are in conformity with the Kardam *et al.* (2005) [33] who were reported that number (s) of siliqua per plant, number (s) of seeds per siliqua and number (s) of siliqua per main raceme had positive direct effect on seed yield per plant (g). Yadav *et al.* (2011) [34] reported that number (s) of siliqua per plant had positive direct effect on seed yield per plant (g). Dawar *et al.* (2018) [35] demonstrated that seed yield per plant had positively directly affected by number (s) of siliqua per plant, plant height, number (s) of seeds per siliqua and had negatively directly affected by siliqua length. Gupta *et al.* (2018) [26] reported that seed yield per plant had positive direct effect by harvest index, number (s) of secondary branches per plant, number (s) of seeds per siliqua. An overall observation of path coefficient analysis in the present investigation revealed that days to 50% flowering, days to maturity, plant height, number of primary branches, number of secondary branches and number of siliquae on main raceme are important factors for the seed yield and common genes may play an important role for their expression. Therefore, due consideration must be given to these traits while, practicing selection for yield improvement. Thus, it may be suggested that the best ideotype for Indian mustard will be those having high yield with more number of siliquae, high harvest index and biological yield. The significantly positive association and high direct effect on seed yield suggests that more effective selection should be oriented towards selecting the plants for more number of siliquae, high harvest index and high biological yield per plant, thus ultimately it will be resulting in higher seed yield.

Table 3: Phenotypic path coefficient analysis for yield and its component characters in Indian mustard

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of primary branches per plant	Number of secondary branches per plant	Number of siliquae on main raceme	Biological yield	Seed yield per plant (g)
Days to 50% flowering	-0.2967	0.0107	-0.0653	0.0251	0.0188	0.0333	0.1010	-0.1935
Days to maturity	-0.0073	0.2024	-0.1004	-0.0638	0.0306	-0.0019	0.0520	-0.0290
Plant height (cm)	0.0316	-0.0713	0.1438	0.0421	-0.0019	0.0422	-0.0064	0.1101
Number of primary branches per plant	-0.0319	-0.1192	0.1107	0.3781	0.0831	0.2003	0.1473	0.3150
Number of secondary branches per plant	-0.0213	0.0507	-0.0045	0.0737	0.3354	0.0132	0.0281	0.4337
Number of siliquae on main raceme	-0.0031	-0.0003	0.0081	0.0147	0.0011	0.0277	0.0053	0.2390
Biological yield	0.1353	-0.1020	0.0177	-0.1548	-0.0334	-0.0759	-0.3974	-0.0702

Residual effect = 0.7960

Table 4: Genotypic path coefficient analysis for yield and its component characters in Indian mustard

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of primary branches per plant	Number of secondary branches per plant	Number of siliquae on main raceme	Biological yield	Seed yield per plant (g)
Days to 50% flowering	-0.3118	0.0115	-0.0691	0.0255	0.0205	0.0353	0.1083	-0.1950
Days to maturity	-0.0086	0.2317	-0.1161	-0.0760	0.0354	-0.0026	0.0602	-0.0307
Plant height (cm)	0.0345	-0.0781	0.1558	0.0464	-0.0021	0.0458	-0.0070	0.1105
Number of primary branches per plant	-0.0339	-0.1355	0.1229	0.4131	0.0928	0.2223	0.1629	0.3195
Number of secondary branches per plant	-0.0214	0.0497	-0.0044	0.0729	0.3246	0.0128	0.0274	0.4359
Number of siliquae on main raceme	-0.0009	-0.0001	0.0024	0.0044	0.0003	0.0082	0.0016	0.2398
Biological yield	0.1469	-0.1099	0.0190	-0.1668	-0.0357	-0.0821	-0.4228	-0.0694

Residual effect= 0.7901

Genotypic path coefficient analysis revealed that and number of primary branches per plant (0.4131) had the highest positive direct effect on seed yield per plant followed by number of secondary branches per plant (0.3246), days to maturity (0.2317), plant height (0.1558) and number of siliquae on main raceme (0.0082).

Reference

1. Reddy BN. Correlation studies in Indian mustard. Indian J. Oilseeds Res. 8: 248- 250.Robinson, H.F., Comstock, R.E. and Harvey. P.H. (1949). Estimates of heritability and the degree of dominance in Corn. Agron. Jr. 1991;41:353-359.
2. Syed SA, Ali A, Rehman K. Improvement of rapeseed for agronomic and quality characters through induced mutation and hybridization. Viena; c1994. p. 25-35.
3. Uddin MJ, Chowdhury MAZ, Mia MFU. Genetic variability, character association and path analysis in Indian mustard (*Brassica juncea* L.). Ann. Of Bangladesh Agric. 1995;5(1):51-54.
4. Tyagi PK, Singh D, Rao VUM, Kumar A. Correlations & path coefficient analysis in Indian mustard (*Brassica juncea*). Jr. Crop Res. Hissar. 1996;11(3):319-322.
5. Kaushik SK. Association analysis of morphological characters in taramira (Eruca sativa Mill.) M.Sc. (Ag.) Thesis submitted to Rajasthan Agricultural University, Bikaner, Campus- Jobner; c1998.
6. Hussain S, Hazarika GN, Barua PK. Genetic variability, heritability and genetic advance in Indian rapeseed (*Brassica campestris* L.) and mustard (*B. juncea* Czern and Coss). Progressive Research: An International Journal. 1998;11(2):260-261.
7. Karkoo SK, Jindla LN, Satija DR. Genetic determination of seed yield through its components in Indian mustard (*Brassica juncea* (L.) Coss.). Crop Improv. 2000;27(2):247-249.
8. Larik AS, Rajput LS. Estimation of selection indices in *Brassica juncea* L. and *Brassica napus* L. Pak. Jr. Botany. 2000;32(2):323-330.
9. Jajoria RN. Genetic divergence for seed yield and its components in taramira (Eruca sativa Mill). M.Sc. (Ag.) Thesis, Submitted to Rajasthan Agricultural University, Bikaner, Campus-Jobner; c2001.
10. Jankowski K, Budzynski W. The role of yield components in the management of yielding of some spring oilseed crops. Rosliny Oleiste. 2003;24(2):443-454.
11. Khan RSA, Khan FA. Evaluation of genetic potential of some Brassica germplasm collections. International Journal of Agriculture of Biology. 2003;5(4):630-631.
12. Mahla HR, Jambhulkar SJ, Yadav DK, Sharma R. Genetic variability, correlation and path analysis in Indian mustard [*Brassica juncea* (L.) Czern and Coss.]. Indian J Gen. and Pl. Breed. 2003;63(2):171-172.
13. Singh Poonam, Singh DN, Chakraborty M. Variability, heritability and genetic advance in Indian mustard (*Brassica juncea* L.). J Res. 2003;5(1):45-47.
14. Dastidar KKG, Patra MM. Character association for seed yield components in Indian mustard (*Brassica juncea* L. Czern and Coss). Jr. Inter academicia. 2004;8(2):155-160.
15. Upadhyay DK, Kumar K. Analysis of heritability and genetic advance in relation to yield and its components in indian mustard (Brassica juncea L. Czernand Coss) under normal and late sown conditions. International J. of Plant Scie. (Muzaffarnagar). 2009;4(1):12-14.
16. Patel K, Vyas SR. Heritability and genetic advance in barley under partially reclaimed saline-sodic soil. Rachis. 2011;(1-2):56-57.
17. Tahira Tariq Mahmood Tahir, Usman Saleem Makhdoom Hussain Muhammad Saqib MS. The estimation of heritability, association and selection criteria for yield components in mustard (Brassica juncea). Pakistan Journal of Agricultural Sciences. 2011;48(4):251-254.
18. Uke AP Deotale, Tumdam RD, Patil JS, Kalamkar SRVB. Pathanalysis of morphophysiological, biochemical and yield contributing traits in mustard (*Brassica juncea*). Journal of Soils and Crops. 2011;21(2):285-289.
19. Kumar P, Lamba A, Yadav RK, Singh L, Singh M. Analysis of yield and its components based on heterosis and combining ability in Indian mustard (*Brassica juncea* L. Czern & Coss), The Bioscan. 2013;8(4):1497-1502.
20. Maurya JS, Mohammadi K, Talebi R. Interrelationships and genetic analysis of seed yield and morphological traits in mini core collection of Iranian landrace, breeding lines and improved Indian mustard (*Brassica juncea*) cultivars. Genetika. 2013;47(2):383-393.
21. Nagendra Maurya, Singh AK, Singh SK. Path coefficient analysis in Indian mustard (*Brassica juncea* L.). Advances in Plant Sci. 2013;26(1):273-274.
22. Saleem M, Zafar A, Ahsanand M, Asalam M. Interrelationships and Variability Studies for Grain Yield and its Various Components in Indian Mustard [*Brassica juncea* (L.) Czern and Coss]. Journal of Agriculture and Social Science. 2017;3(29):266-269.
23. Ali N, farhatullah Khan NU, Rabbani MA, hussain I, Ali S, Khan SA, Kakar MQ. Genetic diversity of Brassica

Rapa L. indigenous landraces based on cluster and principal component analyses. Pakistan Journal of Botany. 2017;49(5):1891-1901.

24. Devi TR, Devi ND, Vivekananda Y, Sharma PR. Genetic diversity analysis in Indian mustard (Brassica juncea L. Czern and Coss) genotypes using agro-morphological parameters. Electronic Journal of Plant Breeding. 2017;8(3):749-753.
25. Devi B. Correlation and path analysis in Indian mustard (*Brassica juncea* L.) in agro–climatic conditions of Jhansi (U.P.). Journal of Pharmacognosy and Phytochemistry. 2018;7(1):1678-1681.
26. Gupta Anuj, Chandra Pant Naveen, Dwivedi Upendra, Tiwari Shailendra, Pandey CS, Dhoundiyal Rakesh, *et al*. Studies on correlation and path coefficient analysis for yield and yield related traits in Indian mustard (*Brassica juncea* L. Czern & Coss.) under timely and late sown conditions. Journal of Pharmacognosy and Phytochemistry. 2018;7(2):2545-2551.
27. Kumar A, Nath S, Yadav AK. Variability and heritability analysis in F4 genotypes of *Brassica juncea* L. Bangladesh Journal of Agricultural Research. 2018;39(2):227-241.
28. Rout Sanghamitra, Kerkhi SA, Chauhan Charupriya. Character Association and Path Analysis among Yield Components in Indian Mustard [*Brassica juncea* (L.) Czern and Coss] Int. Jr. Curr. Microbiol. App. Sci. 2018;7(1):50-55.
29. Roy RK, Kumar Anand, Kumar Sanjay, Kumar Anil, Kumar RR. Genetic Variability studies in Indian Mustard [*Brassica juncea* (L.). International Journal of Current Microbiology and Applied Sciences Special Issue-6: 1881-1884. Environment and Ecology. 2018;36:247-254.
30. Pal S, Dubey N, Avinashe H, Khan S, Reddy JP. Estimation of Genetic variability, correlation and path analysis for yield and yield contributing characters in Indian mustard (*Brassica juncea* L.) Journal of Pharmacognosy and Phytochemistry. 2019;1:102-105.
31. Singh J. Correlation and Path Studies for Seed Yield and Its Attributing Traits in Indian Mustard [*Brassica juncea* (L.) Czern & Coss.] Int. Jr. Curr. Microbiol. App. Sci. 2020;9(9):620-626 620
32. Yadav RK, Yadav Ram Gobind, Shweta. Genetic variability and path coefficient analysis for seed yield and its related attributes in Indian mustard (*Brassica juncea* L. czern and coss.) under late sown condition. Progressive Agriculture. 2020;20:117-122.
33. Kardam DK, Singh VV. Correlation and path analysis in Indian mustard (*Brassica juncea* (L.) Czern & Coss) grown under rainfed condition. Journal of Spices and aromatic crops. 2005;14(1):56-60.
34. Yadav SS, Redden RJ, Hatfield JL, Lotze-Campen H, Hall AE. Crop adaptation to climate change. John Wiley & Sons; 2011 Oct 25.
35. Tabesh S, Davar F, Loghman-Estarki MR. Preparation of γ-Al2O3 nanoparticles using modified sol-gel method and its use for the adsorption of lead and cadmium ions. Journal of Alloys and Compounds. 2018 Jan 5;730:441-449.